# Soviet Science and Engineering Education and Work Force Policies: Recent Trends

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SOVIET SCIENCE AND ENGINEERING EDUCATION AND
WORK FORCE POLICIES: RECENT TRENDS

Soviet education in the sciences and engineering has been characterized by major quantitative achievements and serious qualitative and administrative shortcomings, resulting in a very uneven system. Efforts to fit the Soviet situation into an American framework frequently lead to overestimations of the meaning of quantitative success or failure to appreciate genuine achievements. The best Soviet institutions and individuals are very, very good. The problem is that the layer of top quality is thin, the drop-off below that layer is steep, and much of what is achieved is dissipated by a grotesquely inefficient economic and administrative apparatus.

Mikhail Gorbavchev is now telling his people that quantitative achievements are not enough. Having one-quarter of the "scientific workers" and one-half of the engineers in the world employed in the Soviet Union does not automatically translate into scientific achievement or technological superiority. In accord with an overall policy of "restructuring" (perestroika) and "instensification" in the economy, the entire education system is being overhauled. Changes that have been in preparation for many years are being speeded up and expanded, and additional areas have been identified for reform. The thrust of these changes is to overcome the inertia and lack of creativity that have long characterized most of Soviet education, while establishing a system that meets the needs of in the "scientific-technical revolution."

## SKETCH OF THE SOVIET EDUCATION SYSTEM

While differing in many important respects from the US system, Soviet education does have levels of training that essentially correspond to familiar American patterns.[1] Soviet general and specialized secondary programs are basically parallel to American secondary education, but also overlap somewhat with junior and technical colleges. What the Soviets call "higher education" may be equated with American college/university education. And Soviet advanced degree programs correspond roughly to American graduate and post-graduate programs.

### The Secondary Education System

The Soviet elementary and secondary education system prior to 1986 was composed of the following levels:

-Primary/elementary education: grades 1-3

-"Incomplete" secondary education: grades 4-8

-"Complete" secondary education: grades 9 & 10 of the general education school, and varied programs at technical schools,

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[1]For descriptions of the Soviet education system see Mervyn Matthews, Education in the Soviet Union: Policies and Institutions Since Stalin (London: Allen & Unwin, 1982); Harley Balzer, "Science, Technology, Education," The Soviet Union Today James Cracraft (ed.) (Chicago: University of Chicago Press, 1983), pp. 233-243, 2nd edition forthcoming; and Nicholas DeWitt, Education and Professional Employment in the USSR (Washington, DC: National Science Foundation, 1961.) For a comparison of the American and Soviet systems, see Catherine Ailes and Francis W. Rushing, The Science Race (New York: Crane Russak, 1982).

specialized secondary educational institutions, and evening and correspondence divisions of some secondary schools.2

The system provides a "unified" school of a single type for all students through grade 8 (incomplete secondary education). Following 8th grade (normally at age 15) a student has the options of continuing in the general education school for an additional two years, enrolling in a technical or vocational school, or entering the labor force, with the assumption that secondary education will be completed in an evening or correspondence division of one of the secondary schools. Those who choose to remain in the general education secondary school for 9th and 10th grades choose a path upon graduation: higher education, a specialized secondary or technical school, or a job. Virtually all young people complete eight years of secondary school, and nearly all finish the full secondary education program in some type of institution. While access to higher education is open to everyone with a secondary education, the overwhelming majority of students who enter higher education are graduates of the 9th and 10th grades of a general education school.

In discussing Soviet math and science education it is crucial to note the role played by special schools and courses. There are specialized schools for math and science, foreign languages, and other special profiles, including sports, theater, and culture.

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2In the three Baltic Republics and some other areas the general education school has an 11-year curriculum. Much of the extra time is devoted to the additional language study required for mastery of both the local native language and Russian.

Efforts are made to identify the most promising prodigies and track them to appropriate educational institutions, especially the math and science boarding schools. Many of theselurred special schools have developed relationships with higher education institutions to facilitate their students' admission to advanced study. A large percentage of students intending to enter higher education take some type of extra "optional" courses and many work with a tutor to prepare for the entrance exams.3

There is an extensive network of secondary technical schools and "professional-technical" schools. Some of these institutions admit students after 8th grade, and prcvide an equivalent to "complete" secondary education as well as technical training. Other programs accept students after 10th grade, providing only specialized instruction. Over 200 ministries, departments and committees are i:volved in the administration of these schools, making coordination difficult. In general, professional-technical schools have been geared to training skilled workers, while secondary technical schools (technicums) have trained technicians. Recently this distinction has been blurred somewhat, as

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[3]On the special schools see John Dunstan, Paths to Excellence and the Soviet School (Windsor, Berks: NFER Publishing Co., 1977); and Bruce Ramon Vogeli, Soviet Secondary Schools for the Mathematically Talented (Washington, DC: National Council of Teachers of Mathematics, 1968.

Recently the role of special schools has been intensely debated in the Soviet press, but these debates have focused on schools offering special training in foreign languages. The math and physics schools have not been subjected to criticism. For a summary of some of the debates see Current Digest of the Soviet Press March 25, 1987, 39:8, pp. 1ff.

professional-technical schools are converted to "secondary professional-technical schools."

**Higher education**

Soviet higher education has been characterized by rapid growth, geographic concentration and administrative diversity. A far smaller proportion of young people receive higher education than in the US (approximately 20% as opposed to over 50%), but a much greater percentage of those in higher education (about half, compared to less than 20% in the US) study science and engineering.

Inheriting from the tsarist era a system with slightly more than 100 institutions of higher education, overwhelmingly concentrated in Moscow and Leningrad, and many of only recent origin, the Soviet regime has increased the number of schools to 896, and the number of students to over five million. There are currently about 15 million individuals with higher education working in the USSR.[4] Enrollments expanded almost continuously over the past century. However, there now is a feeling that growth has reached its optimum, and the number of students has declined since 1982. It is very important to note that about 40% of students attend evening and correspondence institutions, and these part-time programs account for perhaps 1/3 of higher school graduates. The evening and correspondence programs are widely criticized as being of inferior quality.

Educational institutions are heavily concentrated in a few major urban centers, particularly Moscow and Leningrad. While this

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[4] SSSR v tsifrakh v 1986 godu.

phenomenon is characteristic of most European nations, the degree of concentration in the Soviet Union is extreme, particularly as regards top quality institutions. Moscow alone has 76 higher educational institutions (vysshie uchebnie zavedeniia or VUZy), including some of the largest institutions in the USSR. One graduate in nine receives his/her diploma from a Moscow VUZ.[5] Moscow institutions also perform a major share of scientific research, by one estimate one-third of the basic research and one-quarter of the applied research carried out at VUZy in the USSR.[6]

The 896 institutions of higher education encompass a range of schools of different types, subject to diverse administrative supervision. The system includes about 65 universities and a similar number of polytechnical institutes. Every third VUZ is a technical institute of some type. Most Soviet higher educational institutions are narrowly focused on particular specialties. Even at Universities and Polytechnical Institutes, students are admitted to specific faculties and their five-year programs of study are rigidly specified.

While most of the institutions offering higher education in science and technology are under the Ministry of Higher and Specialized Secondary Education (MinVuz), there are also institutions involved in S&T education in the Ministries of Agriculture, Health, Highways, Communications, Marine, Civil

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[5]Srednee spetsialnoe obrazovanie No. 11, 1982:13.

[6]Pravda July 2, 1982:2.

Aviation, the River Fleet, Defense, and the Navy. The range of quality among these institutions is quite great. The universities run the gamut from Moscow University, the acknowledged top-rank institution with fifteen departments (faculties) and over 100 research laboratories, making it one of the world's leading centers of scientific and technical research, to a number of provincial universities engaged primarily in the training of teachers for local schools. Only about ten of the universities conduct significant research across a broad spectrum, while over half do not have any affiliated research labs. Technical and polytechnical institutes manifest a similar range. Official Soviet sources distinguish four distinct types of technical institutes, based on the level of research work carried out.

While the formal administrative subordination of each school is stated in official regulations, ambiguity results from many institutes' affiliations with industrial ministries, "base enterprises" and "education-science-production associations." Most VUZy receive part of their funding and equipment, and also some of their guidelines for admitting students in particular specialties and conducting research, from branch ministries. With the widespread introduction of base enterprises and science-production associations, individual enterprises have also come to play a greater role in the life of VUZy.

**Graduate Programs**

Graduate study is the place where Soviet practice differs most notably from American patterns. In addition to programs of graduate study (aspirantura) at higher educational institutions, the Soviet system permits scientists and engineers to earn advanced degrees at scientific research institutes and institutions of the Academy of Sciences. The advanced degrees themselves also differ from American categories.

The two advanced degrees offered in the USSR are Candidate of Science (kandidat nauk) and Doctor of Science (Doktor nauk). The kandidat degree corresponds in some ways to an American PhD.[7] It is generally earned by younger scholars who have completed their initial period of mandatory employment following graduation from a VUZ. (In unusual cases, a promising student may be permitted to continue study immediately following graduation from a VUZ.) Most graduate students at VUZy have been sent by their places of employment, with the expectation that they will return after completing their degrees.

A major difference between the Soviet and American systems is the degree-granting role of Soviet research institutions. Approximately 40% of Soviet graduate students earn their degrees at research institutes rather than at VUZy. This provides an

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[7]The question of equivalence of the kandidat degree to the American PhD has been difficult to resolve. There is no equivalent to the Masters Degree in the USSR, and many kandidat degrees appear to have been awarded for work tht would fall somewhere between the MA and PhD level. As is true of American PhDs, the standards and quality of work vary between institutions and also depend on the dissertation mentors.

opportunity for young researchers to earn degrees for work in progress, but also makes quality control a problem. The quality of the degree will reflect the strength of the individual research institution and the standards of its Scientific Council, the group of scholars empowered to confer higher degrees.

The Soviet Doctoral degree corresponds more closely to a German Doctorate or the French These than to an American PhD. It is awarded to a senior scholar who has already achieved significant status in a field, and is awarded as much for the corpus of work as for a specific dissertation. Most Soviet Doctors of Science are at the level of Full Professors at American universities.

## SECONDARY EDUCATION REFORMS

The reform of general and secondary education announced in 1984 is a sweeping, long-term program.[8] It is motivated by economic and demographic pressures, and intended to generate educated personnel suited to the requirements of a modern, high-tech economy. For science and technology, the following provisions are of major importance:

Additional time: An additional year is being added to the general education program, by having most children begin their education at age six rather than age seven. General education will

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[8]For discussion of the general education reforms see: Beatrice Beach Szekely, "The New Soviet Educational Reform," Comparative Education Review Vol. 30 No. 3 (1986) pp. 321-343; John Dunstan, "Soviet Education Beyond 1984: a commentary on the reform guidelines," Compare Vol. 15, No. 2 (1985) pp. 161-187; Delbert Long, Educational Reform in the Soviet Union, Special Studies in Comparative Education, No. 14 (Buffalo, NY: SUNY Buffalo, 1985).

now be an 11-year course (12 years in the areas where it is currently 11). The extra year will allow time for study of additional subjects such as labor education, computer science, and ethical and family issues that are being introduced in response to changes in society and developments in science and technology.

Vocational Training: Faced with a need for both more workers and a more highly trained labor force, Soviet planners have opted to re-emphasize what they call "polytechnical" education. Every student is to learn labor skills in manual training courses and master a workers' specialty in secondary school. Even those who go directly to higher education must demonstrate their mastery of a worker's specialty.

In addition to a more vocationally oriented curriculum in the general education schools, more students are being encouraged to enter professional-technical schools (PTUs) rather than continuing with the final two years of the general education curriculum at regular secondary schools. Initially Soviet educators envisioned doubling the proportion of students attending PTUs, to as much as 2/3 of the school-age population. Expansion of this magnitude would require major construction of new facilities and would create serious dislocations. With the decision to require increased vocational training for all students, the goal for PTU enrollments appears to have been reduced to perhaps 40% of students.

Curriculum: Curriculum changes may have the greatest impact on science and technology, and on the preparation of candidates for

higher education. Soviet educators have rejected the "new math" and advanced science curriculae developed since the 1960s as being excessively complex and overly demanding. New programs are being developed that seek to simplify these courses while simultaneously bringing education into accord with the needs of a modern economy. The changes include new, less demanding but more comprehensive (sic) curriculae in most subjects, an expanded program of vocational training, and introduction of new courses in social science, vocational guidance, and computer literacy.9

There is no small irony for American observers in what has occurred with the curriculum reform. The much vaunted Soviet math and science curriculum, object of much attention and some genuine fear in the US,10 has been judged unsuitable for the USSR in the era of restructruing and intensification. Debates over the curriculum are continuing in the USSR, and it will be several years before new textbooks are developed and the new programs can be fully tested.

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9Valuable annotated translations of the new curriculum for specific subjects are available in the journal Soviet Education: Jan. 1987 (Mathematics); Feb. 1987 (Geography); and March-April 1987 (Science). Critical commentary on the new programs in math and science is presented in Soviet Education XXIX:8. June, 1987.

10Isaac Wirszap "Soviet Secondary School Mathematics and Science Programs", paper presented at NATO Symposium on Soviet Scientific Research, Brussels, Sept. 24-26, 1986, proceedings forthcoming from Martinus Nijhoff, Dordrecht, 1987; U.S. Congress, House Committee on Science and Technology, US Science and Engineering Education and Manpower: Background, Supply and Demand; and Comparison with Japan, the Soviet Union and West Germany (Washington, DC: USGPO, 1983).

Computer literacy: The ability to use computers has been declared a major priority, and computer science has been accorded a prominent place in the new curriculum. All Soviet secondary school students are to learn the basics of information science in a newly designed course. The problem here is the availability of hardware. The Soviet Union still has not managed serial production of a reliable personal computer. Several new models are in various stages of development, and recently a contract was signed to purchase up to 100,000 PCs from a Peruvian company.11 Even if some of these machines find their way into the schools, there are problems with maintenance, servicing and providing qualified teaching staff. It is not surprising that the new textbook for "Fundamentals of Information Science and Computer Technology" has been printed in two versions: one for schools with computers and one for schools without computers.

Additional resources: The priority accorded to the education reform can be measured by the allocation of an additional 11 billion rubles at a time when the Soviet economy is in serious difficulty. Nearly 1/3 of these funds will go to increasing teachers' salaries, both across-the-board and in merit pay arrangements. The higher salaries have already encouraged more young people to apply to pedagogical institutes. Most of the

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11I am grateful to Seymour Goodman of the University of Arizona for bringing this to my attention. The best survey of the current status of Soviet computing is Seymour E. Goodman and William K. McHenry, "Computing in the ISSR: Recent Progress and Policies" Soviet Economy 1986 2:4, pp. 327-354.

additional funds will be used to provide equipment for the schools, including computers, and to cover administrative expenses.

Beyond allocations from the state budget, each school is to receive assistance from a "base enterprise." These base enterprises are supposed to provide financial and material assistance to the schools, including facilities for vocational training, and receive benefits in the better-trained workers who will eventually enter their employ. This type of collaborative effort requires cooperation by enterprise managers and school administrators. Thus far, it is working very well in a few model programs, but the vast majority of base enterprises have not yet geared up to implement the reform.

Tracking: The combination of increased vocational emphasis and encouraging more students to enter PTUs has the effect of making eighth grade a much more important decision point. Despite assertions that universal vocational education guarantees equality of opportunity, it is not likely that large numbers of PTU graduates will subsequently enter higher education. However, even if the number continuing in the general education program at secondary schools were to be halved, there would still be 2.5 to 3 graduates to compete for every available VUZ opening. The changes will not have a major impact on educational institutions. They will be significant for individuals, but the number of applicants at the better VUZy suggests that institutions will continue to have some choice in admitting students. The most signficant factor

affecting the results of tracking will be the VUZ admissions system.12

## CURRENT TRENDS IN HIGHER EDUCATION

The "restructuring" of higher and specialized secondary education was announced in 1986, in the midst of an intense debate over what types of changes to institute. Discussion is continuing, and the changes promulgated thus far indicate that many key aspects of the reform remain to be resolved.13 One important result will be increasing diversity, as some responsibilities are delegated to individual institutions and policies are designed for particular types of schools, and as programs of study become less rigid.

Numbers: Enrollments in Soviet higher education peaked in 1982, and have been declining since. This drop has come from enforcing tougher standards for students already in the pipeline, rather than from a decrease in admissions. The decline affects almost all specialties, with the exception of computer science, biology and a few other areas targeted for expansion. Soviet authorities condiser the number of specialists with higher education in the USSR to be large enough that a five percent

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12It is important to remember that the Ministry of Education and Ministry of Higher and Specialized Secondary Education are separate, independent agencies. They do not always coordinate their policies and directives, and sometimes operate at cross purposes.

13On the higher education reform see Harley Balzer, "The Soviet Scientific-Technical Revolution: Education of Cadres" paper presented at NATO Symposium on Soviet Scientific Research, September 24-26, 1986 (proceedings forthcoming, Dordrecht: Martinus Nijhoffs, 1987).

decrease will not adversely affect the education system or the economy.

The number of VUZy in vitrually all specialties is considered more than adequate, and requests for additional construction will be carefully scrutinized. Some mention has been made of the desirability of closing small, weak and ineffective VUZy, such as provincial pedagogical institutes with few professorial-level faculty and virtually no equipment. However, the Soviet administrative structure has a strong bias against eliminating institutions, and it is not likely that there will be major adjustments in the near future. Some evening programs may be eliminated, and the number of students studying in evening classes has been declining, but this has been compensated by an increase in correspondence course enrollments.

Admissions: The system of admitting students to higher education is currently in flux. Numerous experiments are being tried, and different types of shcools are developing their own arrangements. In the Fall of 1986, the Ministry of Higher and Sepcialized Secondary Education sought to encourage a more serious approach to "professional orientation" by making a personal discussion of career goals part of the admission process, and permitting VUZy to award bonus points toward admission to students who demonstrated aptitude or previous work in their chosen field of study. The result was an administrative disaster, wtih much confusion and widespread abuse. This program has been abandoned, but other efforts are being made to insure that students are more

mature and motivated by an interest in their specialty rather than just a desire to get a higher education.

There is a contradictory trend toward BOTH more objective AND more subjective criteria in admitting students. Oral exams are being replaced by written or computer-graded tests, which are deemed less subject to personal influences. But at the same time, many types of schools are weighing previous specialized education and employment in their admissions decisions. Medical schools plan to admit 80% of their students from those working in auxiliary medical professions or graduating from secondary medical-technical schools. Political considerations are never far below the surface, and political loyalty and extracarricular social service activity, including the common practice of having students help with agricultural work, continue to play an important role in selecting students and awarding stipends. The issue of political/social obligations of students as a criterion for receiving stipends has recently been a subject of debate. The Minister of Higher Education, G. A. Yagaodin, has stated that the best students should receive their stipends regardless of their social attitudes, but that for others willingness to participate in "obligatory" group activities would be a consideration.14

For science and technology, the most important policies involve leading VUZy and the elite secondary schools. Special relationships are being developed. Many of the best VUZy have

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14These remarks were made in an appearance on Soviet television on May 17, 1987.

signed contracts with secondary schools under which VUZ faculty teach special preparatory courses, students spend time at VUZ research labs, and a specified number of the secondary school's graduates are admitted to the VUZ. About 30 VUZy have developed such programs with secondary schools, and their number is growing. These arrangements are being expanded to include base enterprises and scientific research institutions. In its optimal variant, the program provides stable cadres of students who are exposed to scientific research early in their education. But this system asks young people to choose their career and specialty at a very young age, often 15 or 16. The problem of individuals who switch their careers or drop out of the program will not be overcome merely by making the specialties broader.

Curriculum: The major trends in VUZ curriculum are toward individualized instruction and opportunities to conduct research. Soviet higher school curriculae have been noted for their rigidity, compreheniveness, and remoteness from practical applications. Steps are being taken to change this by reducing the number of lectures, while increasing seminars, lab work and other small-group classes. In place of detailed course requirements for each narrow specialty, students are being encouraged to design their own study programs in consultation with professors, to develop a broader "profile," and to become involved in "real" research activities while still in school.

At engineering institutes, emphasis on individualized programs and opportunities for research has been accompanied by an increased

awareness of the importance of social sciences and economics.[15] New standards have been established for computer education at all VUZy.

Faculty: Scientific researchers are even more heavily concentrated in Moscow and Leningrad than are VUZy. Yet even in major centers there has been difficulty attracting top talent to all but the best VUZy due to strict rules forbidding employment at more than one place. New regulations are being promulgated to expand the right of researchers and technical personnel to teach part-time, and it is hoped this will give higher education an infusion of new teachers with practical experience. There are also proposals for new, intensive graduate programs to prepare the best VUZ graduates for teaching positions.

To help improve institutions outside the major urban centers, a program is being organized to encourage senior faculty to teach for up to five years at Siberian and Far Eastern VUZy, with extra pay and the right to retain their previous positions, housing and residence permits. This may encourage some additional mobility. But the most effective way to generate faculty in the provinces is to train local cadres--a solution which raises it own problems.

Placement: The system of planning admissions and placeing graduates has long been one of the weakest aspects of Soviet higher education. Despite much lip service to scientific planning, it has

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[15]The formulation of the issue and suggestions for curriculum changes are strikingly reminiscent of recent discussions at American engineering schools. See Elizabeth M. Fowler, "A Broader View for Engineers" New York Times September 8, 1987, p. D18.

proved impossible to elicit honest and accurate projections of personnel needs from ministries or to insure that graduates work in the specialties for which they are trained. Millions of individuals with advanced education work outside their specialties. Rather than considering diversity of educational background to be an investement in human capital, Soviet leaders regard it as a serious shortcoming.

The problem of individuals not pursuing careers in the specialties for which they are educated is being addressed by attention to vocational guidance and professional orientation, and by development of broader profile specialties for students that will permit a greater range of subsequent career choice. Inducing greater accuracy and responsibility from the ministries and organizations that employ specialists is a more daunting problem. Efforts are being made to make ministries financially accountable for their projections, obligating them to provide assistance to a VUZ for each specialist they wish to have trained, but these provisions are in an early stage of development and will be very difficult to enforce.

## GRADUATE/POSTGRADUATE STUDY IN SCIENCE AND ENGINEERING

The goal of recent initiatives in graduate education is clearly covered by the concept "intensification". Soviet scientific institutions produce too many people with higher degrees, but too few genuine researchers and innovators. Reforms are therefore on two tracks: to eliminate the dead wood, and to

provide more opportunities for creative students.16 It is likely that the number of kandidat degrees awarded will decline, and that standards will be more rigourous. At the same time, it will be easier for the most promising students to continue working toward advanced degrees without interruption. New doctoral programs are to be developed to train VUZ faculty and researchers.

In an effort to encourage more practically oriented dissertations in applied fields, the rules governing dissertation defenses are being changed. It will now be possible to receive a kandidat degree on the basis of a scientific report or invention certificate, without having to complete the full dissertation cycle. Throughout the scientific community an attack is being mounted against what are perceived to be "small" themes and research topics of little practical benefit. The transition from planning to "self-financed" economic activity will certainly encourage this tendency.

Salaries are being increased for top students when they enter the labor force, and also for scientists and engineers whose work is judged to be of high quality. Increases of as much as 50% have greatly improved some engineers' living conditions. It will not be possible to improve every S&T worker's living standards, but the stratum receiving higher salaries is expanding.

Soviet planners recognize that in an era of rapid scientific and technical progress, no education program can be considered

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16The fullest discussion of proposals in graduate education came in an interview with Mr. Kirillov-Ugrumov, Chairman of the Higher Attestation Commission, Izvestiia August 30, 1986, p. 3.

final. Everyone working in the sciences needs periodic retraining and upgrading of skills. New legislation mandates "recertification" of scientific workers every five years, with the expectation that individuals will attend programs of retraining and supplementary education at least that often. Previous experience suggests that elite personnel will continue to benefit from such initiatives, but that the human and material resources are not sufficient to offer retraining to all who need it.

## CONCLUSION

The current Soviet education reforms are clearly contradictory, manifesting a tension between the need for creativity and the desire to channel personnel into appropriate education and job slots with minimal waste of resources. The American system subsidizes and directs only a small portion of specialists, leaving most decisions to individuals acting in response to their own desires and the vagaries of the market. In the Soviet Union, those with an aptitude for math and science often are identified at an early age and enrolled in accelerated programs. The state pays for all education, but in return seeks to guarantee that its investment is repaid by individuals working where they are needed. The system does not make it easy for mavericks, late bloomers and others who opt for non-standard career patterns, there is little understanding that these might be the very creative individuals it needs.

Soviet successes are also contradictory. They churn out a tremendous number of scientists and engineers. By the law of averages, some of these people are very talented. Many of the ordinary engineers and scientific workers are fit only to serve as technicians. Soviet leaders have now recognized that the ability to compete with advanced industrial societies requires more attention to quality as opposed to quantity, and are seeking to alter their education system accordingly.

Developments in sceince and technology are causing similar responses in the American and Soviet education systems. In both nations, more attention is being paid to secondary school math and science. Both countries perceive a need for engineering training that is broader and more oriented to social and economic as well as technical subjects. Just about everyone recognizes that rapid developments in science and technology render almost any education obsolete in one or two decades, and that the solution is to provide a general foundation that can be supplemented by subsequent retraining. The extent of current Soviet reforms suggests that, like everyone else, they have not found satisfactory solutions to these problems.

## TYPES OF VUZY

| | |
|---|---|
| Universities | 66 |
| Polytechnical Institutess | 64 |
| Branch Industrial VUZy | 164 |
| Transport and Communications | 39 |
| Agriculture and Veterinary | 76 |
| Surveying and Forestry | 13 |
| Economics, Commerce and Management | 39 |
| Jurisprudence | 4 |
| Medicine and Pharmacology | 84 |
| Pedagogy | 220 |
| Physical Culture | 23 |
| Art, Music & Theater | 59 |
| TOTAL: | 850* |

* ThIS total is 46 less than official statistics for the USSR. The missing institutes are probably military, foreign ministry and intelligence community institutions.

Source: Compiled by the author from Spravochnik dlia postupaiushchikh v vysshie uchebnye zavedeniia SSSR v 1986 godu (Handbook for Matriculants at Higher Educational Institutions, 1986) Moscow: Vysshaia shkola, 1986.

## BRANCH INDUSTRIAL VUZY UNDER MINVUZ

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|---|---|
| Industrial and Engineering Education | 11 |
| Factory-VTUZy | 5 |
| Energy, Electrical technology, Engineering-physics and Physical-technical | 14 |
| Machine-building, Instrument construction, Mechanization and Automation | 16 |
| Chemical machine-building | 2 |
| Shipbuilding | 2 |
| Aviation | 8 |
| Polygraphics | 2 |
| Film engineering | 1 |
| Geology, Mining and Oil | 11 |
| Mining and Metallurgy | 9 |
| Chemical technology | 15 |
| Food industry | 13 |
| Fisheries industry | 0 |
| Textiles, Light Industry and Housewares | 13 |
| Engineering-construction | 30 |
| Geodesy | 2 |
| Automobile and Highway | 5 |
| Hydro-meterology | 5 |
| TOTAL | 164 |

Source: Compiled by the author from Spravochnik dlia postupaiushchikh v vysshie uchebnye zavedeniia SSSR v 1986 godu (Handbook for Matriculants at Higher Educational Institutions, 1986) Moscow: Vysshaia shkola, 1986.

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